BOTTOM EMITTING VCSEL (VERTICAL CAVITY SURFACE EMITTING LASER) WITH MONITOR EMISSION THROUGH TOP MIRROR

FIELD OF THE INVENTION

The present invention relates to a method of monitoring the light output from a VCSEL and more particularly, the present invention relates to a method of monitoring the light emission from a VCSEL without interfering with the light output from the VCSEL.

BACKGROUND OF THE INVENTION

Previously, when mounted in a header, light that was reflected from the top lens of the VCSEL back into the header was monitored with a Si photodiode, on which the VCSEL chip was mounted. Presently, the art has not recognized any method of monitoring the light from a VCSEL chip that is not mounted in a header. The use of a header is required in existing systems to monitor light emission.

In many applications it is desirable to know for certain that the VCSEL is in fact emitting light upon current being driven through it. The problem is to monitor this light without disturbing the lightbeam too much, and to conduct this in an affordable manner that does not require complex packaging.

The present invention provides methodology to monitor the light emission from a VCSEL without in any way obstructing and/or disturbing the output light. It also eliminates the need of mounting the VCSEL chip in a header just to monitor its output light.

SUMMARY OF THE INVENTION

One object of one embodiment of the present invention is to provide a surface emitting laser, comprising:

a plurality of spaced apart mirrors;

a light amplifying region between the mirrors;

a substrate; and

a photon transparent ohmic contact for passing light energy therethrough whereby light emission through the surface emitting laser may be monitored.

A further object of one embodiment of the present invention is to provide a method for monitoring light emission from a surface emitting laser, the laser including:

a plurality of spaced apart mirrors;

a light amplifying region between the mirrors;

a substrate;

a photon transparent ohmic contact;

contacting the laser with a source of energy to generate light; and

monitoring emitted light transmitted through the transparent ohmic contact.

Having thus generally described the invention reference will now be made to the accompanying drawings illustrating preferred embodiments.

Figure 1 is a schematic illustration of the prior art arrangement for monitoring light output;

Figure 2 is a schematic illustration of a standard VCSEL showing the loss of light to the substrate; and

Figure 3 is a schematic illustration of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Similar elements employed in the drawings denote similar elements.

Referring now to the drawings, Figure 1 depicts a conventional arrangement, generally denoted by numeral 10, for monitoring light 12 emitted from a VCSEL 14. The light 12 reflected from top lens 16 and on to photo diode 18. In this embodiment, the light is detectable only by the photo diode and as such, the arrangement is limited as discussed hereinabove.

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In Figure 2, a standard VCSEL is illustrated having an ohmic contact 20, a substrate 22 and reflective mirrors, the high reflectivity mirror being denoted by numeral 24 and the low denoted by numeral 26.

As is known with VCSELs, one of the two mirrors reflects less (and transmits more) of the light incident upon it from the amplifying region. The light transmitted through this less reflecting mirror is the light that is emitted from the VCSEL. This light is shown in Figure 1 by the arrow indicated by numeral 28. In the standard top-emitting VCSEL illustrated, light denoted by arrow 30 is lost as it is emitted into the substrate 22 below the bottom (high reflectivity) mirror 24 if it is not of a wavelength to which the substrate is transparent. However, in a bottom emitting VCSEL, shown in Figure 3, where the light emitted through the less reflecting mirror 26 passes through a hole 32' in the substrate, nothing stops the light 28 that is transmitted through the high reflectivity mirror 24, except the ohmic contact 34 that is placed on the other side of that mirror. By providing an aperture 32 in the ohmic contact 34, it is possible to extract that light and monitor it with a diode (not shown) on which the VCSEL chip 14 can be placed.

Generally speaking, a photon transparent contact is one that allows light emission through it via an aperture or is made of a transparent material. Further, the contact may be made sufficiently thin to allow passage of light or the contact may incorporate a combination of these features.

In a further aspect of the invention, the same can be used for any bottom-emitting VCSEL, including those that have wavelengths for which the substrate is transparent. Where the substrate is transparent, no aperture has to be made through the substrate in order to allow primary (i.e. not the monitor) light to be extracted from the VCSEL structure. For such VCSELs, the standard VCSEL design allows the monitor light to be extracted through the substrate, making bottom emission of the primary light unnecessary. To extract the monitor light through the ohmic contact (for both standard and bottom emitting VCSELs), it is not necessary to make an aperture in the contact. Instead, the contact may be made out of a photon transparent material (for example, but not limited to, ITO (Indium Tin Oxide)), or the contact can be made sufficiently thin to allow light to pass through it. In this regard, the contact may have a thickness of between 1 nm (nanometer) and 100 nm.

Although embodiments of the invention have been described above, it is not limited thereto and it will be apparent to those skilled in the art that numerous modifications form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.